

What is claimed is:

1. A reflection liquid crystal display comprising:

a first substrate;

5 a second transparent substrate that is disposed forward to the light-incident direction so that it is opposed to said first substrate;

10 a color filtering layer consisting of a liquid crystal layer placed between said first substrate and second substrate, and a cholesteric material layer secured between said first substrate and said liquid crystal layer;

an optical absorbing layer provided rearward of said color filtering layer in the light-incident direction at said first substrate side;

15 a quarter-wavelength plate secured at said second substrate side; and

a polarization plate disposed further forward in the light-incident direction than said quarter-wavelength plate.

2. A reflection liquid crystal display comprising:

a first substrate;

20 a second transparent substrate that is disposed forward to the light-incident direction so that it is opposed to said first substrate;

a color filtering layer consisting of a liquid crystal layer placed between said first substrate and second

25 substrate, and a cholesteric material layer secured between said first substrate and said liquid crystal layer;

an optical absorbing layer provided rearward of said color filtering layer in the light-incident direction at

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said first substrate side; and

a three-prime-color cholesteric material layer having inverted twisting of said cholesteric material layer, which is provided at said second substrate side.

5           3. The reflection liquid crystal display as set forth in Claim 1, further comprising a scattering layer for scattering light forward to said polarization plate in the light-incident direction.

10           4. The reflection liquid crystal display as set forth in Claim 2, further comprising a scattering layer for scattering light forward to said three-prime-color cholesteric material layer in the light-incident direction.

15           5. The reflection liquid crystal display as set forth in Claim 3, wherein said scattering layer includes:

two transparent electrodes opposed to each other; and  
a macromolecular dispersion liquid crystal layer placed between said transparent electrode;

wherein transmission and scattering of said macromolecular dispersion liquid crystal layer are switched  
20 by applying voltage to said macromolecular dispersion liquid crystal layer.

6. The reflection liquid crystal display as set forth in Claim 4, wherein said scattering layer includes:

25           two transparent electrodes opposed to each other; and  
a macromolecular dispersion liquid crystal layer placed between said transparent electrode;

wherein transmission and scattering of said macromolecular dispersion liquid crystal layer are switched

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by applying voltage to said macromolecular dispersion liquid crystal layer.

7. The reflection liquid crystal display as set forth in Claim 1, further comprising:

5 a plurality of scanning signal lines secured on the surface of said first substrate opposed to said second substrate;

a plurality of picture signal lines disposed on these scanning signal lines in the form of a matrix;

10 a plurality of thin-film transistors formed so as to correspond to the intersection of said scanning signal lines and said picture signal lines;

at least one pixel that is constituted by an area surrounded by said plurality of scanning signal lines and  
15 picture signal lines;

pixel electrodes that are connected to said thin-film transistor corresponding to respective pixels and are formed rearward of said liquid crystal layer in the incident direction of light; and

20 a common electrode that is formed forward of said liquid crystal layer in the incident direction of light and applies a reference voltage to said plurality of pixels.

8. The reflection liquid crystal display as set forth in Claim 2, further comprising:

25 a plurality of scanning signal lines secured on the surface of said first substrate opposed to said second substrate;

a plurality of picture signal lines disposed on these

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scanning signal lines in the form of a matrix;

a plurality of thin-film transistors formed so as to correspond to the intersection of said scanning signal lines and said picture signal lines;

5 at least one pixel that is constituted by an area surrounded by said plurality of scanning signal lines and picture signal lines;

pixel electrodes that are connected to said thin-film transistor corresponding to respective pixels and are formed rearward of said liquid crystal layer in the incident direction of light; and

a common electrode that is formed forward of said liquid crystal layer in the incident direction of light and applies a reference voltage to said plurality of pixels.

15 9. The reflection liquid crystal display as set forth in Claim 7, wherein at least either one of said scanning electrode or a picture signal electrode is provided with a part of said pixel electrode and a shielding electrode forward in the light-incident direction.

20 10. The reflection liquid crystal display as set forth in Claim 8, wherein at least either one of said scanning electrode or a picture signal electrode is provided with a part of said pixel electrode and a shielding electrode forward in the light-incident direction.

25 11. The reflection liquid crystal display as set forth in Claim 7, wherein said pixel electrode is circular or equilaterally polygonal to have more sides than those of a triangle;

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a common electrode has a larger area than that of said pixel electrode when being observed from upside, and is formed at a position where said common electrode covers the entirety of said pixel electrode.

- 5        12. The reflection liquid crystal display as set forth in Claim 8, wherein said pixel electrode is circular or equilaterally polygonal to have more sides than those of a triangle;

10        a common electrode has a larger area than that of said pixel electrode when being observed from upside, and is formed at a position where said common electrode covers the entirety of said pixel electrode.

- 15        13. The reflection liquid crystal display as set forth in Claim 7, wherein said pixel electrode is shaped so that a plurality of circles or equilateral polygons which have more sides than those of a triangle are connected to each other; and said common electrode has a larger area than that of said pixel electrode when being observed from upside, and is formed at a position where said common  
20        electrode covers the entirety of said pixel electrode.

- 25        14. The reflection liquid crystal display as set forth in Claim 8, wherein said pixel electrode is shaped so that a plurality of circles or equilateral polygons which have more sides than those of a triangle are connected to each other; and said common electrode has a larger area than that of said pixel electrode when being observed from upside, and is formed at a position where said common electrode covers the entirety of said pixel electrode.

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15. The reflection liquid crystal display as set forth in Claim 11, wherein said common electrode is formed on almost the entire surface of said second substrate.

5 16. The reflection liquid crystal display as set forth in Claim 12, wherein said common electrode is formed on almost the entire surface of said second substrate.

17. The reflection liquid crystal display as set forth in Claim 13, wherein said common electrode is formed on almost the entire surface of said second substrate.

10 18. The reflection liquid crystal display as set forth in Claim 14, wherein said common electrode is formed on almost the entire surface of said second substrate.

15 19. The reflection liquid crystal display as set forth in Claim 11 wherein said pixel electrode has cuts formed at equidistant positions on its circumference or at respective corners of an equilateral polygon.

20 20. The reflection liquid crystal display as set forth in Claim 12 wherein said pixel electrode has cuts formed at equidistant positions on its circumference or at respective corners of an equilateral polygon.

21. The reflection liquid crystal display as set forth in Claim 13 wherein said pixel electrode has cuts formed at equidistant positions on its circumference or at respective corners of an equilateral polygon.

25 22. The reflection liquid crystal display as set forth in Claim 14 wherein said pixel electrode has cuts formed at equidistant positions on its circumference or at respective corners of an equilateral polygon.

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23. The reflection liquid crystal display as set forth in Claim 11, wherein said pixel electrode has projections formed at equidistant positions on its circumference or at respective corners of an equilateral polygon, which protrudes outward therefrom.

24. The reflection liquid crystal display as set forth in Claim 12, wherein said pixel electrode has projections formed at equidistant positions on its circumference or at respective corners of an equilateral polygon, which protrudes outward therefrom.

25. The reflection liquid crystal display as set forth in Claim 13, wherein said pixel electrode has projections formed at equidistant positions on its circumference or at respective corners of an equilateral polygon, which protrudes outward therefrom.

26. The reflection liquid crystal display as set forth in Claim 14, wherein said pixel electrode has projections formed at equidistant positions on its circumference or at respective corners of an equilateral polygon, which protrudes outward therefrom.

27. The reflection liquid crystal display as set forth in Claim 7, wherein a recess is formed at a part of said pixel electrode.

28. The reflection liquid crystal display as set forth in Claim 8, wherein a recess is formed at a part of said pixel electrode.

29. The reflection liquid crystal display as set forth in Claim 1, wherein said liquid crystal layer includes

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a macromolecular organic compound.

30. The reflection liquid crystal display as set forth in Claim 2, wherein said liquid crystal layer includes a macromolecular organic compound.

5           31. The reflection liquid crystal display as set forth in Claim 1, wherein said liquid crystal layer has negative dielectric anisotropy in liquid crystal, and liquid crystal molecules are oriented in a direction orthogonal to said first and second substrates when no voltage is applied.

10           32. The reflection liquid crystal display as set forth in Claim 2, wherein said liquid crystal layer has negative dielectric anisotropy in liquid crystal, and liquid crystal molecules are oriented in a direction orthogonal to said first and second substrates when no voltage is applied.

15           33. The reflection liquid crystal display as set forth in Claim 31, wherein said liquid crystal layer is given a pre-tilt angle in advance in a direction along which the liquid crystal molecules are shifted down when voltage is applied.

20           34. The reflection liquid crystal display as set forth in Claim 32, wherein said liquid crystal layer is given a pre-tilt angle in advance in a direction along which the liquid crystal molecules are shifted down when voltage is applied.

25           35. The reflection liquid crystal display as set forth in Claim 1, wherein said liquid crystal layer has positive dielectric anisotropy in liquid crystal and has a twisted nematic structure when no voltage is applied.

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36. The reflection liquid crystal display as set forth in Claim 2, wherein said liquid crystal layer has positive dielectric anisotropy in liquid crystal and has a twisted nematic structure when no voltage is applied.

5        37. The reflection liquid crystal display as set forth in Claim 35, wherein said liquid crystal layer in respective pixels has two types of minute areas whose rise directions of liquid crystal molecules are different from each other.

10       38. The reflection liquid crystal display as set forth in Claim 36, wherein said liquid crystal layer in respective pixels has two types of minute areas whose rise directions of liquid crystal molecules are different from each other.

15       39. The reflection liquid crystal display as set forth in Claim 35, wherein said liquid crystal layer in respective pixels has two types of minute areas whose twisting directions of liquid crystal molecules are different from each other.

20       40. The reflection liquid crystal display as set forth in Claim 36, wherein said liquid crystal layer in respective pixels has two types of minute areas whose twisting directions of liquid crystal molecules are different from each other.

25       41. The reflection liquid crystal display as set forth in Claim 35, wherein said liquid crystal layer in respective pixels has four types of minute areas whose twisting directions and rise directions of liquid crystal

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molecules are different from each other.

42. The reflection liquid crystal display as set forth in Claim 36, wherein said liquid crystal layer in respective pixels has four types of minute areas whose twisting directions and rise directions of liquid crystal molecules are different from each other.

43. The reflection liquid crystal display as set forth in Claim 35, wherein the pre-tilt angle of liquid crystal molecules at the boundary phase between said first substrate and second substrate is 1 degree or less.

44. The reflection liquid crystal display as set forth in Claim 36, wherein the pre-tilt angle of liquid crystal molecules at the boundary phase between said first substrate and second substrate is 1 degree or less.

45. The reflection liquid crystal display as set forth in Claim 1, wherein said liquid crystal layer has positive dielectric anisotropy in liquid crystal, and has a homogenous structure when no voltage is applied.

46. The reflection liquid crystal display as set forth in Claim 2, wherein said liquid crystal layer has positive dielectric anisotropy in liquid crystal, and has a homogenous structure when no voltage is applied.

47. The reflection liquid crystal display as set forth in Claim 45, wherein said liquid crystal layer in respective pixels has two types of minute areas whose rise directions of liquid crystal molecules are different from each other.

48. The reflection liquid crystal display as set

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forth in Claim 46, wherein said liquid crystal layer in respective pixels has two types of minute areas whose rise directions of liquid crystal molecules are different from each other.

5           49. The reflection liquid crystal display as set forth in Claim 47, wherein the pre-tilt angle of liquid crystal molecules at the boundary phase between said first substrate and second substrate is 1 degree or less.

10           50. The reflection liquid crystal display as set forth in Claim 48, wherein the pre-tilt angle of liquid crystal molecules at the boundary phase between said first substrate and second substrate is 1 degree or less.

51. A method for producing a reflection liquid crystal display, comprising the steps of:

15           forming a thin-film transistor on a first substrate;  
            forming an optical absorbing layer on said first substrate;

            forming a color filtering layer consisting of a cholesteric material layer on said optical absorbing layer;

20           forming a pixel electrode on said color filtering layer and connecting the same to said thin-film transistor;

            forming a common electrode on a second substrate;

            making said pixel electrode of said first substrate opposite to said common electrode of said second substrate,

25           and forming a liquid crystal layer including a macromolecular organic compound between said first substrate and second substrate;

            forming a quarter-wavelength plate on said second

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substrate; and

forming a polarization plate on said quarter-wavelength plate;

wherein the step of forming said liquid crystal layer  
5 further including the steps of:

pouring liquid crystal including monomer or oligomer  
between said first substrate and said second substrate; and  
making said monomer or oligomer macromolecular in  
liquid crystal.

10 52. The method for producing a reflection liquid  
crystal display as set forth in Claim 51, further comprising  
the step of forming a pre-tilt angle at liquid crystal  
molecules of said liquid crystal layer by irradiation of  
light after the step of forming said liquid crystal layer.

15 53. The method for producing a reflection liquid  
crystal display as set forth in Claim 52, wherein said  
irradiation of light is diagonally carried out with at least  
any one of said first substrate and second substrate.

20 54. The method for producing a reflection liquid  
crystal display as set forth in Claim 52, wherein said  
irradiation of light is diagonally carried out with  
polarized light for said first and second substrates.

25 55. The method for producing a reflection liquid  
crystal display as set forth in Claim 52, wherein said  
irradiation of light is carried out with polarized light for  
said first and second substrates from the perpendicular  
direction.

56. A method for driving a reflection liquid crystal

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display defined in Claim 1, wherein said display is dot-invertedly driven by inverting the polarities (positive and negative) of voltage applied onto a liquid crystal layer of pixels adjacent to each other.

5           57. A method for driving a reflection liquid crystal display defined in Claim 2, wherein said display is dot-invertedly driven by inverting the polarities (positive and negative) of voltage applied onto a liquid crystal layer of pixels adjacent to each other.

10           58. A method for driving a reflection liquid crystal display defined in Claim 1, wherein pixels are displayed to be black by changing voltage applied onto a liquid crystal layer before one frame is finished.

15           59. A method for driving a reflection liquid crystal display defined in Claim 2, wherein pixels are displayed to be black by changing voltage applied onto a liquid crystal layer before one frame is finished.

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